



Use of Sludge Waste as Ingredient in Making of Brick

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Abstract

Waste may be defined as an unwanted material generated after the manufacturing process from industry, agriculture, or from house hold activity. Waste causes many nuisances in the environment. It produces many types of infection, for human and animal. The sludge from tannery effluent plants has problem of disposal. Dewatered sludge is disposed off by land filling. However, it is not an appropriate solution, due to the land limitation. The production of sludge in tannery effluent plant is about to increase every year. In addition, the constraint to treat sludge is very high in cost and time-consuming, which is the disadvantage to the responsible parties. Therefore, this study was carried out to utilize those sludge waste (SW) produced from the tannery effluent plant as a brick. The sludge brick (SB) mixtures were incorporated with many ratios of SW. Tests were conducted such as fineness test, specific gravity, water absorption and compressive strength. As the conclusion, brick with 20% utilization of SW is acceptable to produce good quality of brick. This study shows that the disposal of tannery sludge TSW would act as a suitable material for manufacturing of bricks with proportionate mix and design.

1. Introduction

General

For the past thousands of years, the bricks were made out of clay. The sludge from (WTP) is almost similar to brick's clay. Its chemical composition is also similar. Therefore this sludge can be used efficiently as a replacement for clay brick. It is mainly focused on characteristics of heavy metal in brick and its influence on modifying the chemical-physical properties, throughout the concentrations, bio-availability and chemical such as Cu, Cr, Zn, Cd and Pb in the tannery waste sludge. The natural resource is practically utilized for manufacture of sludge bricks, and as an alternative to normal cement bricks, which helps in conservation of naturally available resource and improves the environment quality.

Tannery Sludge

Tannery industries are continuously creating more environmental problem, particularly in polluting organic matters and dangerous solid waste from skin, hides processing. The tanning industry is one of the oldest, largest and fastest growing industries in South

East Asia. About 55% of total leather is processed from Tamilnadu and many tannery units are spread over in Chennai, Ambur, Ranipet, Vaniyambadi, Erode, Dindigul, and Trichy. More than 70% operating tannery industries adopt chrome tanning process and 30% adopt vegetable tanning process. Effluent Treatment Plant (ETP) is connected to the Common Effluent Treatment Plant (CETP). There are 14 operating CETPs in Tamil Nadu.

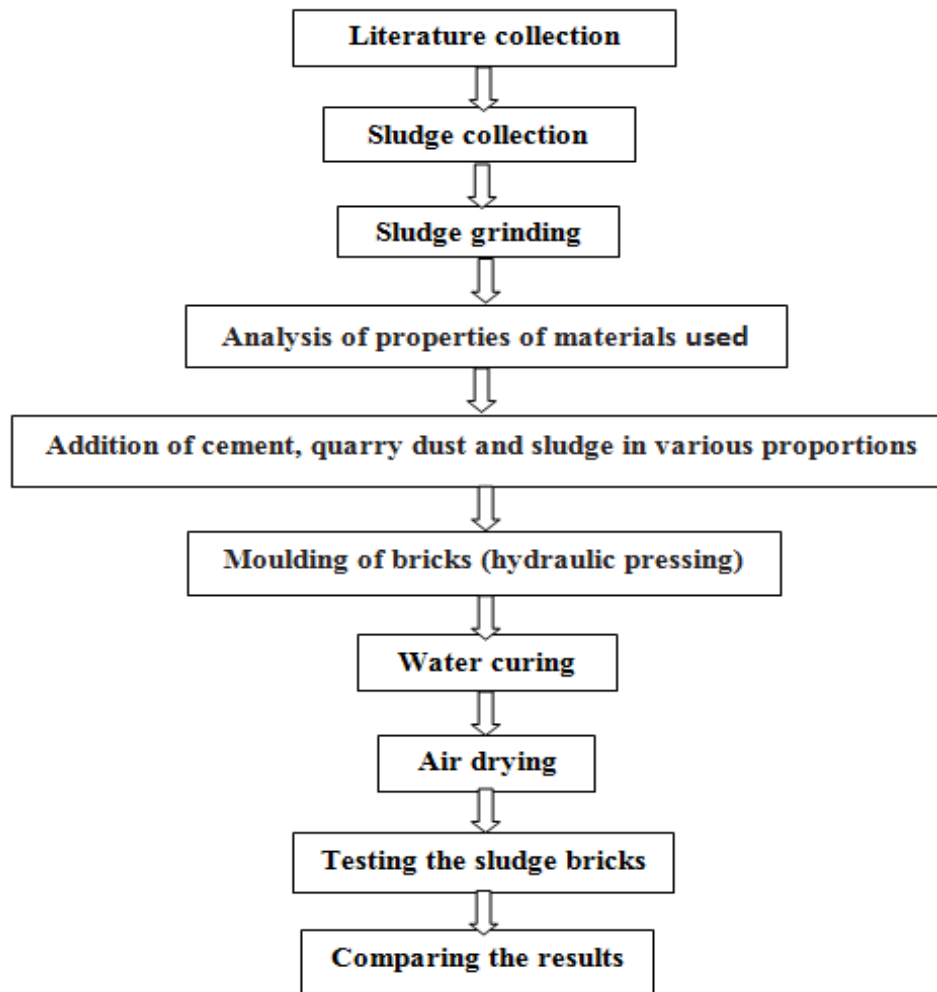
The CETP at Pallavaram treats around 3000 m³/day of wastewater from the tanneries and process mostly semi finished to finished leather product. It is named as Pallavaram Tanners Industrial Effluent Treatment Co., (PTIETC). Pallavaram is an industrial area in southern part of Chennai metro and located on the Trichy -

Chennai National Highway. There are almost 200 tanneries operating in and around Pallavaram area.

Scope of Project

- Higher strength should be obtained.
- Should be economical.
- Inspiring and innovative materials should be used.
- To decide the exact ratio that will be practically feasible.
- Reduction in volume of cement.

2. Methodology



3. Literature Review

TITLE: Usage of Sludge as a Construction Material by J. Balasubramanian a, P.C. Sabumon a, John U. Lazar a, R. Ilangovan

Content: The compressive strength of 10%, 20%, 30% sludge is 4 N/mm², 3.74 N/mm², and loads were given as per IS: 2185(part1) – 1979. From the result 30% of replacement is ok for manufacturing non structural elements

TITLE: Characterizations and Composting of Tannery Sludge by Mahdi Haroun, Azni Idris 1 & S.R. Syed Omar.

Content: In this study the characteristics of sludge from tannery industry and its properties during composting were discussed. Sludge waste from leather industry is producing up to 600 tons of sludge has more amount of inorganic nitrogen (N) organic residues.

TITLE: Treatment of textile sludge using anaerobic technology by Oladoja and Bamuza Pemu

Content: This paper focuses on appropriate treatment process of sludge by anaerobic digestion method. The sludge was dewatered with a sand bed and disinfection process was carried by adding some calcium oxodichloride (CaOCl₂) until residual chlorine came between 0.2 and 0.7 mg/L. The percentage decrease/increase in the solid content, BOD and COD values, nitrogen content, phosphorus concentration and NPK content of raw and treated sludge. There was reduction of about 53% of

phosphorus in the sludge while its quantity in the liquid is increased by 59.53%.

4. Experimental Program

Material Used

- Cement
- Quarry dust
- Tannery Sludge
- Water

5. Test Programmes

Details of Specimens

The specimen used for this test was 70.45mm X 70.45mm X 70.45mm cubes. For material testing different apparatus was used based on the test.

Testing of Cement

Fineness Test:

The fineness of cement is calculated by passing the cement through 90mm sieve. If the fineness increases, dry shrinkage cracks will form easier.

$$\text{Fineness of cement} = (W1 - W2 / W1) \times 100 = 6\%$$

Standard Consistency Test

Consistency is defined as an amount of water required to prepare a plastic mix. It is used to find the quantity of water for mixing with cement. It is also necessary to find the consistency amount as the amount of water present in the cement mortar may affect its setting time. The consistency of this cement is 33%

S.No	% of water added to cement	Quantity of water added	Initial reading	Final reading
1.	25	100	50	40
2.	26	4	50	39
3.	27	4	50	38
4.	28	4	50	36
5.	29	4	50	29
6.	30	4	50	20
7.	31	4	50	16
8.	32	4	50	10
9.	33	4	50	6

The Setting Time Test

- Initial setting test
- Final setting test

Specific Gravity Test

With the apparatus density bottle and weighing balance, the following procedure was done to determine the specific gravity of cement. 100gm of cement is weighted 990 ml of kerosene is filled in a specific gravity bottle. The cement sample is placed in a specific gravity bottle, till the level of kerosene reaches 100ml mark the quality of cement placed in the bottle is calculated. Then the specific gravity of cement is found out by using the following reaction specific gravity of cement = weight of cement (volume of 10ml by weight of kerosene of equal volume of cement. Specific gravity of cement = 3.19

Testing of Tannery Sludge

Specific Gravity Test

The same procedure was followed to determine the specific gravity of sludge. Instead of cement we used sludge in that procedure. Specific gravity of sludge = $W5 \times (W3 - W1) / (W5 + W3 - W4) \times (W2 - W1)$. by calculating using the formula we got specific gravity of sludge as 2.90

Fineness Test

The fineness test was done for the dry sample of sludge. 100gms of sludge was sieved horizontally for for about 10 to 15 min and then residues in each sieve was weighed. From that we came to get the fineness value as 7%, which is higher than cement.

Testing of Quarry Dust

Specific Gravity Test

The specific gravity of quarry dust that we had got selected gives a value of 2.612. This value is slightly coincides with the specific gravity value of sand so that instead of sand we have used quarry dust.

Sieve analysis

The fineness value of quarry dust is calculated by sieve analysis process. With the use of graph we have got the uniformity coefficient value as 2 and coefficient of curvature as 1.125.

Moulding of Sludge Bricks

General

Four sets of sample ratios were taken with some addition in original brick. The specimens used for the test includes cubes of (7.04X7.04X7.04)cm for compression test, three specimens were casted tested for the required age and average values were taken. the tests were conducted for 7 days and 14 days.

Proportions of material added

Different sets were taken in account and their strengths were examined the proportions are as follows,

S NO	SET 1 (%)	SET 2 (%)	SET3 (%)	SET4 (%)
QUARRY DUST	60	60	50	30
CEMENT	20	10	30	20
SLUDGE	20	30	20	50

6. Experiments

Compressive Strength

Compressive strength = Load / Area of specimen used KN/mm²

SET 1

Table 6.1.1: Load calculations of set 1 for 7 days and 14 days

S.NO	WEIGHT OF CUBE (gms)(7)	LOAD IN KN	WEIGHT OF CUBE (gms)(14)	LOAD IN KN
1	648	24	666	26
2	649	26	663	28
3	643	24	661	28

SET 2

Table 6.1.2: Load calculations of set 2 for 7 days and 14 days

S.NO	WEIGHT OF CUBE (gms)(7)	LOAD IN KN	WEIGHT OF CUBE (gms)(14)	LOAD IN KN
1	492	12	524	10
2	487	14	522	12
3	490	10	526	14

SET 3

Table 6.1.3: Load calculations of set 3 for 7 days and 14 days

S.NO	WEIGHT OF CUBE (gms)(7)	LOAD IN KN	WEIGHT OF CUBE (gms)(14)	LOAD IN KN
1	571	12	626	14
2	598	14	620	16
3	580	12	624	12

SET 4

Table 6.1.4: Load calculations of set 4 for 7 days and 14 days

S.NO	WEIGHT OF CUBE (gms)(7)	LOAD IN KN	WEIGHT OF CUBE (gms)(14)	LOAD IN KN
1	515	10	560	12
2	533	12	550	12
3	520	10	543	10

Water Absorption Test

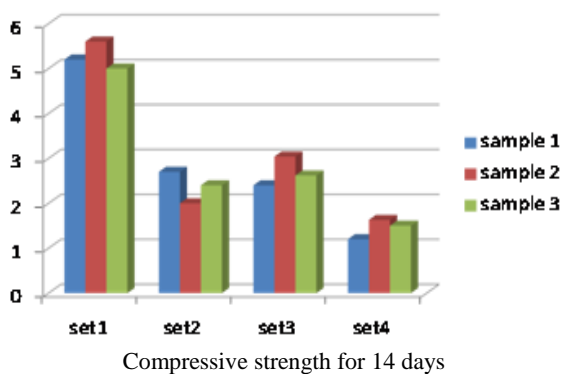
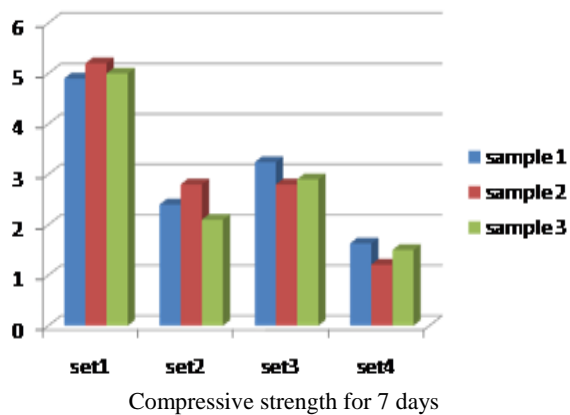
Dry weight of the Sludge brick = 3.5 kg

Wet weight of sludge bricks = 3.92 kg

Water absorption = $(3.92 - 3.5 / 3.5) \times 100$

= 12%

Bar Chart for Compressive Strength



Advantages of Using Sludge Bricks

- Good Strength.
- Environmental Friendly bricks.
- Water absorption in 24 hours is less than 15%.
- Load bearing bricks.
- Low price and high quality.
- Save cement in masonry work
- Reduce the cost of construction.
- Reduce cement consumption by 20%.

Cost Analysis

One bag of cement (50 kg)	=Rs.320
Quarry dust 1 TON	=Rs.450
Sand 1 cuft	= Rs.45
Brick size	= 09x03x2 inch
For 1 Cement bricks:-	
Sand 60% (1.0626 X 10 ³ m ³)	= Rs.4.80
Cement 40% (7.084 X 10 ⁴ m ³)	=Rs.1.75
Labour cost	= Rs.0.75
Machine rent	= Rs 0.50
Finally the cost of one cement brick	= Rs.7.80 (at site)
For 1 Tannery sludge bricks:	
Sludge available	= free of cost
Quarry dust 60% (1.0626 X 10 ³ m ³)	=Rs.1.00
Cement 20% (7.084 X 10 ⁴ m ³)	=Rs 0.875
Labour cost	= Rs 0.75
Machine cost	= Rs.0.50
Finally the cost of one sludge brick is	=Rs.3.125 (at site)

7. Conclusion

The conclusion is based on different experimental sets used, and its tests.

The Water treatment plant sludge (WTP) could be a replacement in conventional brick reinforced with sludge waste from industry, with high chrome content.

The researched brick type will be a big competitor to the cement brick and clay brick type in the market.

The maximum value of compressive strength was obtained in the 20% of sludge replacement in bricks.

Set 1 (60% quarry dust, 20% cement and 20% sludge) could be applicable for structural applications.

Set 2 (60% quarry dust, 10% cement and 30% sludge) could be applicable for non-structural applications.

Set 3 (50% quarry dust, 20% cement and 30% sludge) could be applicable for non-structural applications.

Set 4 (20% quarry dust, 30% cement and 50% sludge) will not be suitable for both structural and non structural applications.

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